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Original Article

EFFECT OF PELLETIZATION WITH BENTONITE ON EMERGENCE OF CARROT SEEDS

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ABSTRACT

Many vegetable seeds are small, light and irregular in shape and therefore, it is difficult to plant them precisely. Sowing these problematic seeds with protective layers of coatings may be the solution to ensure its safe handling. The carrot seed pelleting improves the size and shape of the seeds and thereby improving the mechanical metering of carrot seeds. The control treatment (T1) did not receive any coating, and other four treatment combinations are: Maida gruel with bentonite coated seeds with 2-3mm size (T2), Maida gruel with bentonite coated seeds more than 3 mm size (T3), Gum acacia with bentonite coated seeds with 2-3mm size (T4) and Gum acacia with bentonite coated seeds more than 3 mm size (T5). Two varieties of carrot seeds were used for the study. The effect of seed pelleting treatments was evaluated and compared with bare carrot seeds in the laboratory and in actual field condition. Pelleted seeds improved germination percentage of carrot significantly.

KEYWORDS: Bentonite, Carrot Seeds, Gum Acacia, Pelleting & Seed Germination

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INTRODUCTION

Carrot is grown from seeds. Sowing of carrot seeds should be done on ridges and furrows or in raised beds. The carrot seeds are sown continuously in rows marked manually. The carrot seeds are very small in size and irregular in shape, making sowing more difficult. Sowing of such seeds is generally done manually using broadcasting or drilling in lines method and thereby very little control over the seed rate, seed spacing, seed depth, line sowing, etc. The plant stand, being uneven, requires thinning and large quantity of costly seed gets wasted. Further, mechanical inter-culture is impossible and demands time and labour intensive. So the plating process improves the size and shape and hence improvement in seed size for mechanical metering of carrot sowing.

During pelleting, inert materials are added to change seed size and shape for improved plant's ability. Small and irregularly shaped seed can be treated as larger, round – shaped seed. Singulation of seed in the field is therefore, easier. For carrot crop precise seed placement is of great advantage, as a uniform root development is assured with equal distance sowing.

Pellets of uniform size and shape can be prepared from the small size and / or irregularly shaped seeds by repeatedly coating them with inert materials (Baladhiya *et al.*, 2011). Pelleting also gives marked increase in crop stand, growth and yield thus, resulting in enhanced farm revenue (Vanangamudi *et al.*, 2003)

Silva *et al.,* (2002) also studied bentonite as a binder for pelleting lettuce seeds. He evaluated it with different combinations of bentonite and PVA, they found that, bentonite aggregates the coating particles and that, a 100% use of bentonite, after drying at 36 C, improved seed quality.

Yadachi *et al.,* (2014) investigated the influence of pre-sowing treatments using biogas slurry coated (T_2) and Thirame coated (T_3) on germination, seedling emergence and plant population of carrot was examined and compared with un-coated carrot seed (T_1) in laboratory and in the field. In the laboratory experiment, the highest germination percentage was 80.4% for treatment T_2 and followed by 76% for treatment T_3. The lowest germination of 68.5% was recorded for treatment T_1. A highest emergence rate of 11.1% was recorded for treatment T_3 followed by 9.88% in treatment T_2. Emergence rate was lowest for treatment T_1. In the field, highest germination was recorded for treatment T_2 (89.5%) followed by the treatment T_3 (79.5%). The lowest germination (73%) was recorded for treatment T_1. An emergence rate of 13.6% was recorded for treatment T_2 followed by 11.2% in treatment T_3 and 7.9% in treatment T_1.

The objective of this study was to determine the influence of seed coating treatments using two binders of Gum acacia and Maida gruel with coating material, Bentonite on germination, seedling emergence of carrot seed was evaluated and compared with bare carrot seeds in the laboratory and in actual field condition. The laboratory experiment was carried out in Seed Science & Technology laboratory, TNAU and the field experiments were carried out in Ooty, The Nilgris the major carrot growing area in TamilNadu.

MATERIALS AND METHODS

Two predominant varieties cultivated in hilly regions of TamilNadu ie. Nantes (V1) and New kuroda (V2) varieties were used for the study.

Seed Pelletizing Equipment

Bare carrot seeds were pelleted with the bentonite coating material, along with two selected binders. Motor operated seed pelletizer specially developed for the study was used for pelletization process. The DC geared motor gets power from 12V Battery. The coating pan fixed at an inclination of 30 (to the horizontal surface.

The motorized seed pelletizer consists of a DC geared motor, Hemispherical pelletizing pan, Timing belt and pulley arrangements mounted on a frame. The speed of coating pan was fixed at 43 rev/s.

Seed Pelleting Process

For pelleting process 10g of clean and graded seed samples was taken, and the seeds were spread on an absorbent surface (paper). The binder solution was filled in a hand sprayer and sprayed over the seeds just to wet them. The moistened seeds were transferred to a glass beaker of 250 ml capacity. Then, small quantities of bentonite powder was sprinkled on the seeds and gently mixed so that, all the seeds were covered with the coating material. The seeds were kneaded with the fingers so that, individual seeds were uniformly coated and also separated each other. The seeds were then transferred to coating pan, with 5 g of bentonite powder. The pan was operated for 5 mins at 43 rev/s of pan. A spray of the binder was given into the pan, when the pan is rotating and visually observed for complete wetting of the pellets. Then, another 5g of powder was added and operated for 5 mins. After 2 passes, the pellets were sieved through 2 and 3 mm sieve to categorize the pellets about 2-3mm size and more than 3mm size pellet groups. Those seeds that did not reach the minimum required size were returned to the machine, to complete the pelleting process for around 2 more times and the

sizes more than 3mm, between 2-3mm seeds were separated. The temperature of hot air for drying was maintained at around 35°C, with the help of a hand held air drier. Similarly, the pelleting experiments were repeated for other selected treatments.

T1 – Raw carrot seed

T2 - Maida gruel (20g/l of water) with bentonite coated seeds with 2-3mm size

T3 - Maida gruel (20g/l of water) with bentonite coated seeds more than 3 mm size

T4 - Gum acacia (20% in water) with bentonite coated seeds with 2-3mm size

T5 - Gum acacia (20% in water) with bentonite coated seeds more than 3 mm size

Physical and Physiological Process

Seeds were randomly taken from the lot; thousand seeds were counted manually and weighed on an electronic balance (least count 0.01g). The process was repeated thrice and the average was taken. The bulk density as the ratio of the mass of the seed sample of the bulk volume, occupied by the sample was measured using a glass beaker. The static coefficient of friction of seeds was determined on Nylon surface. The coefficient of friction was calculated, as the ratio of the friction force to the normal force. The experiments were replicated thrice and the average value was reported.

The physiological quality of seed and seed pellets was evaluated, through germination test. The laboratory germination test was carried out in quadruplicate, using 100 seeds each with 4 sub replicates of 25 seeds, in the paper medium (ISTA, 2009). The test conditions of 20 ± 2°C temperatures and 95 ± 3% relative humidity were maintained, in a germination chamber. At the end of fourteen days, the number of normal seedlings was counted and the mean was expressed, as a percentage. The first germination was counted on the 7th day and last counting was on the 14th day, in laboratory trials.

Seedling Emergence

Sowing of carrot seeds (raw and pelleted) was done on 13th December 2014, using raised beds with the help of hand operated punching device, in actual field condition, at Ooty. Factorial Randomized Block design is used for the optimization of parameters. The plot size was 1000mm ×1000mm, for sowing 100 seeds in a plot at spacing of 100mm ×100mm. Soil moisture was kept sufficiently wet, for germination. The carrot seedling emergence rate was counted for 30 days at each plot, with 3 replications.

RESULTS AND DISCUSSIONS

Physical and Physiological Properties of Carrot Seed

The average geometric mean diameter of carrot seeds was ranged from 1.08-1.11 mm, for raw seeds and 1.81mm for pelleted seeds, whereas the sphericity value ranges from 55 – 64 percent. The range of length, width and thickness was wide, showing good scope for pelleting. The thousand seed mass indicating that carrot seeds were very light. The coefficient of friction on nylon surface was observed to be 0.52. The measured physical properties were furnished with table. 1

In laboratory experiments, the number of plants emerged were counted from 7th day and the 14th day during the germination test in a laboratory. The germination emerged exactly on the 7th day. The highest germination percentage was

observed for treatment T2 and the minimum germination percentage was observed for T1 (control) under laboratory condition. In field conditions, germination was commenced on the 19th day after planting. On 30th day final germination count was observed. Highest germination was recorded for treatment T2 and lowest germination was recorded for treatment T1. The average germination percentage on different days after planting is shown in the table 2 and 3, Figure.2 and 3.

CONCLUSIONS

The influence of seed coating treatments using two binders of Gum acacia and Maida gruel, with coating material on germination, seedling emergence of carrot seed was evaluated and compared with bare carrot seeds in the laboratory, and in actual field condition. The both treatments maida gruel with bentonite coated seeds and gum acacia, with bentonite coated seeds improved germination percentage, and seedling emergence of carrot, significantly.

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Table 1: Physical Properties of Raw and Pelleted Carrot Seeds

Properties	TE	NK	Pelleted seeds
Length,mm	1.47	1.99	2.8
Width,mm	0.97	1.09	1.69
Thickness,mm	0.57	0.63	1.24
Geometric Mean Diameter(mm)	1.08	1.11	1.81
Sphericity (%)	63	55	64
Roundness (%)	54	48	59
Bulk density (g/cc)	0.45	0.44	0.47

Table 1: contd.,			
Thousand seed weight(g)	1.6	2.2	22.4
Angle of repose (degree)	34.5	32.3	29.4
True density (g/cc)	0.62	0.59	0.71
Porosity	0.27	0.25	0.33
Coefficient of friction	0.57	0.55	0.52

Table 2: Germination Percentage of Carrot Seeds under Laboratory Condition for Different Treatments

Replications	**Germination Percentage**				
	T1	**T2**	**T3**	**T4**	**T5**
V1R1	76	92	85	92	76
V1R2	72	84	84	88	68
V1R3	80	96	92	92	88
V1R4	84	92	88	84	92
Average	**78**	**91**	**87.25**	**89**	**81**
V2R1	79	93	81	91	81
V2R2	81	91	88	90	78
V2R3	80	90	85	88	79
V2R4	77	94	82	90	84
Average	**79.25**	**92**	**84**	**89.75**	**80.50**

Table 3: Germination Percentage of Carrot Seeds under Field Condition for Different Treatments

Replications	**Germination Percentage**				
	T1	**T2**	**T3**	**T4**	**T5**
V1R1	79	94	90	88	82
V1R2	81	92	92	91	80
V1R3	82	94	88	89	84
Average	**80.67**	**93.33**	**90.00**	**89.33**	**82.00**
V2R1	78	93	87	88	85
V2R2	81	90	89	91	82
V3R3	80	94	85	90	81
Average	**79.67**	**92.33**	**87.00**	**89.67**	**82.67**

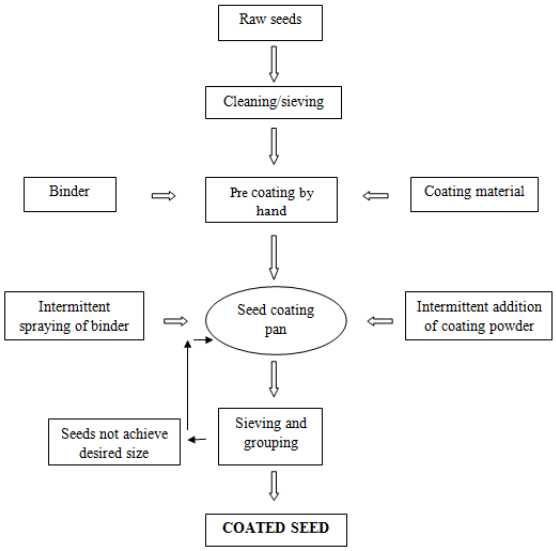

Figure 1: Process of Seed Pelletization

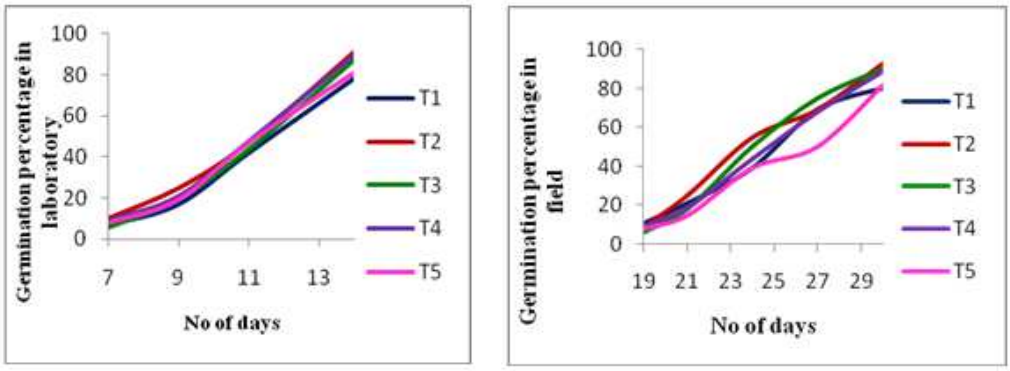

Figure 2: Germination Percentage in Laboratory and Field Condition for Variety 1 under Different Treatments

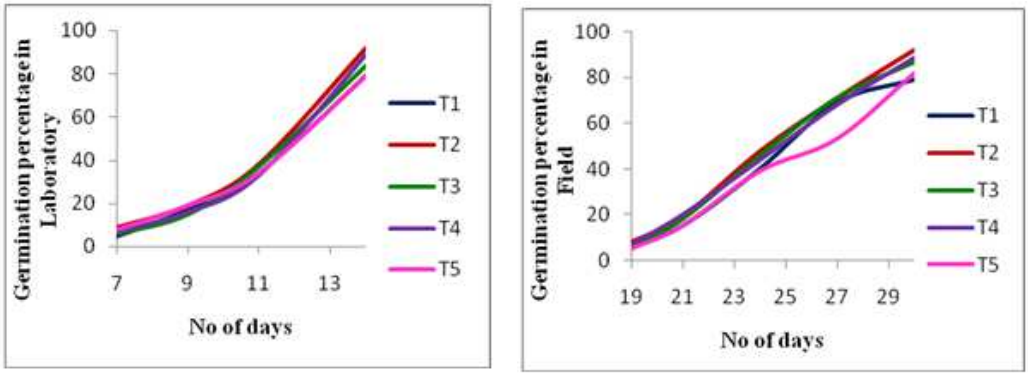

Figure 3: Germination Percentage in Laboratory and Field Condition for Variety 2 under Different Treatments